

A Behavior-Analytic Account of Cognitive Bias in Clinical Populations

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Cognitive bias refers to a well-established finding that individuals who suffer from certain clinical problems (e.g., depression, anxiety, posttraumatic stress disorder, substance abuse, etc.) selectively attend to, remember, and interpret events relevant to their condition. Although a body of literature exists that has tried to examine this phenomenon, most existing explanations are mentalistic and mediational. In this paper we offer a behavior-analytic account of cognitive bias, its development, and how it may contribute to maintenance of clinical problems. This account is based on establishing operations or motivating events, verbal processes, and relational responding. Clinical and future research implications are also discussed.

Key words: cognitive bias, mood congruence, depression, establishing operations, motivating operations, verbal processes

It is well established that certain clinical populations selectively attend to, remember, and interpret events in ways that are congruent with their disorder (e.g., Weingartner, Miller, & Murphy, 1977; Williams, Mathews, & McLeod, 1996). This phenomenon is generally referred to as *cognitive bias* (McNally, 1995). Selective attention, selective memory, attributional biases, and dysfunctional attitudes are examples of cognitive bias and are characteristic of a range of disorders including depression (e.g., Blaney, 1986), posttraumatic stress disorder (e.g., Kaspi, McNally, & Nader, 1995; McNally, Lasko, & Macklin, 1995), obsessive compulsive disorder (e.g., Foa & McNally, 1986), panic disorder (e.g., Becker, Rinck, & Margraf, 1994), specific and social phobias (e.g., Burgess, Jones, Robertson, Radcliffe, & Emerson, 1981), anxiety (McNally, 1995), substance abuse (e.g. Franken, Rosso, &

Honk, 2003), bulimia nervosa (Meyer et al., 2005), and body dysmorphic disorder (Buhlmann, McNally, Wilhelm, & Florin, 2002).

Given the cognitive orientation of the researchers interested in cognitive bias, it is not surprising that existing conceptual accounts are mediational and rely on various postulated cognitive processes and hypothetical cognitive constructs (Beck, 1967; Beck, Rush, Shaw, & Emery, 1979; Bower, 1981). As such, they do not provide a conceptual account that specifies the environmental determinants or the critical functional relations that are imperative for the prediction and control of the phenomenon. Because cognitive bias is a ubiquitous phenomenon and is relevant to a number of clinical disorders, it is important to provide such an account. The purpose of the present paper is to offer a conceptualization that relies primarily on two interdependent behavioral processes: motivating operations (Michael, 1982, 1993, 2000) and the function-altering processes involved in stimulus equivalence (e.g., Sidman, 1994; Sidman, Willson-Morris, & Kirk, 1986) and derived relational responding (Hayes, Barnes-Holmes, & Roche, 2001). Before addressing the role of these behavioral processes in cognitive bias, we will present the

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empirical evidence for the phenomenon.

COGNITIVE BIAS IN CLINICAL DISORDERS

Cognitive bias has been studied using a variety of cognitive tasks, almost all of which assess the relative salience of different classes of stimuli. For example, after exposure to laboratory procedures designed to induce a sad mood, individuals may be asked to study a list of words that contains pleasant, neutral, and sad words. If the individual recalls more sad words after the mood-induction procedure than pleasant or neutral words, he or she is said to have a cognitive bias for the sad words.

Cognitive bias has been studied across a range of clinical disorders; however, it has been most extensively studied in individuals with depression. The content or topography of the cognitive biases may vary among clinical disorders, but the empirical findings as well as the functional relations presented in this paper hold across clinical disorders (Burgess et al., 1981; Foa et al., 2003; Foa & McNally, 1986; MacLeod & Rutherford, 1992; Mathews & MacLeod, 1985; McNally, Kaspi, Riemann, & Zeitlin, 1990; Mogg, Mathews, Bird, & Macgregor-Morris, 1990; Rinck, Reinecke, Ellwart, Heuer, & Becker, 2005; Watts, McKenna, Sharrock, & Trezise, 1986; Williams et al., 1996). Thus, only the data on cognitive bias in depression will be presented.

Cognitive Bias in Depression

Cognitive bias has been investigated most extensively in clinical and laboratory studies of depression. Selective attention, biased memory, and preference for negative events and information are major symptoms of depression (e.g., Beck et al., 1979; Blaney, 1986; Bradley, Lee, & Mogg, 1997; Ellis & Ashbrook, 1989; Roth & Rehm, 1980; Williams et al., 1996). The emotional Stroop task is com-

monly used to measure the personal importance of various stimuli (e.g., Watts et al., 1986; Williams et al.). In this task, participants are presented with a series of colored words varying in emotional content (e.g., *sad*, *bag*) and are required to name as fast as they can the color of each word rather than the actual word. Reaction time is the dependent variable, and it is assumed that the more emotionally relevant the words, the more difficult the task will be, as measured by longer response latencies. The emotional Stroop procedure has been used with individuals with depression, who tend to respond slower to the color of depression-related words than to neutral words (Gotlib & McCann, 1984). Similar effects have also been found for depression-related words with nondepressed individuals after sadness and other negative moods had been induced experimentally (Gilboa & Gotlib, 1997).

The majority of cognitive bias research in depression has focused on selective memory. Studies using depressed participants have shown mood-congruent memory effects, meaning that participants recalled more material when the valence of the material matched their current mood than when the material was inconsistent with their mood. For example, using a repeated measures design to examine the relation between their diurnal depression cycle and autobiographical memories, D. M. Clark and Teasdale (1982) reported that individuals with depression recalled more negative memories during the time of day when they reported being more depressed and more pleasant memories when they were less depressed. This pattern of mood congruence has been replicated across several clinical studies (see Blaney, 1986, for a review). In addition, mood-congruent effects were reported in a study that examined the effects of dysphoria on sentence creation and free-recall tasks (Hertel & El-Messidi, 2006). These findings

suggest that individuals with depression show memory bias effects across a range of memory-assessment procedures.

These clinical findings are consistent with the results of laboratory studies that have examined the relation between mood and cognitive bias. Laboratory studies often use mood-induction procedures to alter participants' moods. A full review of mood-induction procedures is beyond the scope of this paper, but most involve the presentation of written statements, pictures, or music (alone or in combination) that are intended to induce a particular mood or make participants feel a particular way. Using mood-induction procedures, mood-congruent memory effects have been replicated many times. For example, in free-recall situations, individuals in negative mood conditions report significantly more negative autobiographical memories than individuals in neutral or positive mood conditions (Bower, 1981; Natale & Hantas, 1982; Teasdale & Fogarty, 1979; Teasdale & Taylor, 1981; Teasdale, Taylor, & Fogarty, 1980). In contrast, individuals in positive mood conditions recall more pleasant memories. In addition, individuals induced into a positive mood not only described events and people in more positive terms than negative terms but they also use more positive descriptions than individuals in a negative mood (Bower). Furthermore, several studies have found that experimentally induced mood states affect performance on word-recall tasks, such that sad words are more frequently recalled when subjects are in a sad mood, and positively valenced words are more frequently recalled when subjects are in a positive mood (Bower; Ellis & Ashbrook, 1989; Teasdale & Russell, 1983). Furthermore, it has been shown that the relation between memory content and mood is symmetrical (Baker & Gutterfreund, 1993; Van der Does,

2002). That is, asking subjects to recall sad memories induces sad moods. Taken together, these findings suggest that individuals tend to recall events that are congruent with their prevailing mood state.

Although some studies have failed to find mood-congruent memory effects, these failures have been attributed to procedural variables, including the use of nonclinical populations (Blaney, 1986; Hasher, Rose, Zacks, Sanft, & Doren, 1985), tasks requiring low cognitive demand (Challis & Krane, 1988; Ellis, 1985; Ellis & Ashbrook, 1989; Ellis, Thomas, McFarland, & Lane, 1985), and tasks with low personal relevance (Bower & Forgas, 2000). Altogether, mood-congruent recall effects appear to be a robust finding.

Cognitive bias has also been repeatedly demonstrated with cognitive phenomena other than memory. For example, several studies that measured thoughts and attitudes during both clinical and experimentally induced depressed mood have shown that negative thoughts increase in frequency when in a depressed mood and decrease when in a positive or neutral mood (Bodenhausen, Sheppard, & Kramer, 1994; Gotlib, Lewinsohn, Seeley, Rohde, & Redner, 1993; Hollon, Kendall, & Lumry, 1986; Miranda & Persons, 1988). Also, individuals with depression tend to describe themselves in negative ways (Hill & Dutton, 1989) and predict that, in general, they will attain less success and more failure than nondepressed individuals (e.g., Buchwald, 1977; Gotlib, 1981, 1983). Sheppard and Teasdale (2000) reported that depressed participants agreed more readily (i.e., emitted faster response latencies) with dysfunctional attitude statements and less readily (i.e., emitted slower response latencies) with functional attitude statements compared to controls.

Other variables shown to vary as function of mood include self-efficacy

ratings, task persistence, and self-critical or self-blaming attributions. For example, participants in a sad mood-induction condition reported significantly lower estimates of efficacy than subjects in a joyful mood condition (Kavanagh & Bower, 1985). In addition, individuals in a positive mood condition persisted longer on anagram tasks than individuals in a negative mood condition (Kavanagh & Bower).

Both clinically depressed individuals and those in laboratory-induced depressed moods demonstrate self-critical attribution styles (Coyne & Gotlib, 1983; Follette & Jacobson, 1987; Forgas, Bower, & Moylan, 1990; Raps, Peterson, Reinhard, Abramson, & Seligman, 1982; Stiensmeier-Pelster, 1989). For example, individuals with higher levels of depression and comorbid diagnoses endorse a more self-deprecating and blaming attributional style for events with negative outcomes (Barnett & Gotlib, 1988; Fresco, Alloy, & Reilly-Harrington, 2006; Gotlib et al., 1993; Morrison, Waller, & Lawson, 2006; Raps et al.; Stiensmeier-Pelster) while at the same time attributing positive outcomes to external events (Forgas et al.; Fresco et al.; Persons & Rao, 1985). This is in contrast to the self-enhancing attribution style of individuals in positive moods. Nondpressed participants and participants in neutral or positive mood conditions attributed negative outcomes to external causes that are infrequent (Forgas et al.; Forgas & Locke, 2005; Fresco et al.; Gotlib et al.) and attributed positive outcomes to their personal contribution, which they described as occurring regularly and in many contexts (Follette & Jacobson; Forgas et al.; Forgas & Locke; Fresco et al.; Peterson, Villanova, & Raps, 1985). In effect, positive mood correlates with self-enhancement, whereas depressed mood correlates with self-criticism.

Cognitive bias in social information processing has also been

demonstrated with individuals with depression. Gotlib, Krasnoperova, Yue, and Joormann (2004) reported that depressed participants differentially attend to sad faces when given a series of pairs of faces depicting various emotions. Social information processing biases have been paralleled in laboratory-induced moods (for reviews, see Bower, 1981, 1991; Bower & Forgas, 2000). For instance, individuals in a happy mood condition gave more positive descriptions of their friends, whereas participants in an angry mood condition gave more negative descriptions. Similarly, positive mood was associated with increased attention (e.g., in a story, they spent more time reading these characteristics) to positive aspects of a stranger, whereas sad mood was associated with increased attention to the stranger's negative aspects (Forgas, 1992; Forgas & Bower, 1987). These studies also showed that happy and sad participants looked longer at pictures of several common scenes that contained mood-congruent content. That is, happy participants looked longer at happy pictures (e.g., weddings), and sad participants looked longer at sad pictures (e.g., funerals) (Kelly, 1982). There was also a difference in participants' reports of how they planned to spend their time in the coming days. Participants in a depressed mood reported a plan to spend more time in solitary and serious activities, whereas happy participants reported a plan to spend time engaging in enjoyable and light-hearted activities.

In addition, several studies have shown that depressives differentially seek negative social feedback and tend to remember and believe negative feedback more than positive feedback (Giesler, Josephs, & Swann, 1996; Joiner, 1995; Joiner, Katz, & Lew, 1997; Katz, Beach, & Anderson, 1996; Ritz & Stein, 1995; Schaffer, Wickrama, & Keith, 1996; Swann, Griffin, Predmore, & Gaines, 1987; Swann & Read, 1981a, 1981b;

Swann, Stein-Seroussi, & Giesler, 1992). For example, Giesler et al. found that when roommates were asked to list each other's positive and negative characteristics, 82% of those diagnosed as depressed later chose to hear the negative comments listed by their roommates, in contrast to 25% of the nondepressed participants. Moreover, Swann, De La Ronde, and Hixon (1994) reported that depressed participants actually prefer intimate relationships that are characterized by negative feedback. Taken together, these findings suggest that individuals in a depressed mood not only selectively attend to negative social information but they may also be more comfortable in situations that provide such information.

Interestingly, cognitive bias seems to covary with the intensity of depression (e.g., Beck, 1967; Beck et al., 1979; Rush, Weissenburger, & Eaves, 1986; Weingartner et al., 1977). Although laboratory-based mood-induction studies have not consistently shown a relation between negative mood intensity and mood-congruence effects (Blaney, 1986), the clinical depression literature suggests otherwise. For instance, measures of cognitive bias used in depression studies are positively correlated with symptom severity and course (Rush et al.). The association between symptom severity and degree of cognitive bias indicates that cognitive bias may play a role in the maintenance of clinical problems.

There are data that suggest that cognitive styles play a role in the maintenance of mood, despite contradictory environmental input (Barnett & Gotlib, 1988; Coyne & Gotlib, 1983; Teasdale, 1983). Clinical problems often remain long after the initial precipitating event, which suggests the involvement of cognitive or verbal processes. For example, rumination about current and past depressing experiences can maintain depression even in the absence of current negative environmental input

(Fennell, Teasdale, Jones, & Damlé, 1987). Bower and Forgas (2000) reported that depending on the type of cognitive strategies employed, mood and mood disorders can not only be exacerbated but can also be ameliorated.

CONCEPTUAL ACCOUNTS OF COGNITIVE BIAS

Cognitive Accounts

A thorough discussion of cognitive theories of cognitive bias is beyond the scope of this paper, but this approach typically can be summarized by one of the two following positions. The first position posits that beliefs, automatic thoughts, dysfunctional attitudes, attributions, and schemas cause depressed mood (e.g., Beck, 1967; Beck et al., 1979; D. A. Clark, Beck, & Alford, 1999; Ingram, Miranda, & Segal, 1998; Persons & Miranda, 1992). Also suggested by these theories is that negative cognitive styles establish vulnerability to subsequent depression.

Much empirical work has investigated these assertions, and the abundance of evidence does not support cognition as causal in mood disorders (Barnett & Gotlib, 1988; Coyne & Gotlib, 1983; Hammen, Marks, deMayo, & Mayol, 1985; Lewinsohn, Steinmetz, Larson, & Franklin, 1981). Negative cognition appears to be a concomitant and consequence of mood rather than an antecedent, indicating that mood may be primary (Barnett & Gotlib; Coyne & Gotlib; Hammen et al.; Lewinsohn et al.). For example, it has been shown that attribution styles did not differ among remitted depressives and never-depressed controls (Barnett & Gotlib). Longitudinal observations have revealed that as depression scores decreased, reported number of irrational beliefs also decreased (Persons & Rao, 1985), although dysfunctional attitudes have been shown to persist with recent clinical remission (Rush et al., 1986). It is difficult to

discern the etiological relevance of this latter effect, however, because prior episodes of depression may change one's cognitive behavior, perhaps affecting (increasing) the relative baseline of one's dysfunctional attitudes.

Within prospective, longitudinal analysis—the best approach for determining the etiological significance of cognition—cognitive styles have not predicted the onset of depression or the future vulnerability to depression. For example, Lewinsohn et al. (1981) found that depressive cognitive style was absent before the first episode of depression. Results for adolescents further suggest that a negative cognitive pattern is absent before the onset of the first episode of depression, and that the negative cognitive style is in effect only during the depressed mood (Gotlib et al., 1993). Taken together, the data suggest that cognition may not always precede the onset of mood disorders; rather, mood disorders may be the result of some other causal variable.

The second position is that basic emotion nodes that are biologically wired into the brain become activated when in a sad mood, which in turn activates other nodes (e.g., physiological arousal, events, facial expressions, etc.) in the network, which determine what events, labels, appraisals, and behaviors are accessible (Bower, 1981, 1991). These cognitive patterns are proposed as the primary cause of depression, whereas emotional factors are seen as secondary. When a negative emotion is activated, so are the memories, labels, and actions associated with it, so that is what is accessible and apparent. Although this account is compelling in some ways, and later versions of it state that the emotion nodes are activated by environmental events, it is explicitly stated that the concern is not with situational antecedents but specifically with the behavioral and cognitive consequences that are the

result of emotional states. This theory fails to appeal to environmental contingencies in the development of these networks because the assumption is that the structure exists and is activated analogously to an electrical network. Because the theory fails to describe how this develops or how changes to this network might affect associations among these various nodes, it remains, from a behavioral perspective, an inadequate explanation of how cognition might cause mood disorders.

To summarize, current cognitive formulations do not adequately account for the majority of the data. Although they may account for the contribution of negative cognitions to the maintenance of depression, these theories do not explain the reduction in negative cognition to normal levels during remission, nor do they account for the absence of dysfunctional cognitive styles before onset of the first episode of depression. Also, the idea that negative schemas (latent or otherwise) function to produce depression or vulnerability to depression has been disputed in the cognitive literature. Finally, these theories do not explain how maladaptive cognitive behavior patterns emerge.

Ultimately, explanations that give causal status to cognitions are relying on response–response relations, and, as is the case with most mediational accounts, the relevant behavioral processes, environmental determinants, and functional relations that account for the cognitions are not specified. Questions therefore remain concerning the behavioral principles and processes that underlie cognitive bias and their functional relation to the other behavioral components of a mood disorder. However, cognitive theoreticians and researchers have identified a clinically important phenomenon, because the role of cognitive bias in the maintenance of clinical problems cannot be disputed. Given the prevalence of cognitive bias in a wide range of clinical

disorders and its potential role in their maintenance and treatment, it is clearly not epiphenomenal. Thus, a behavioral account of cognitive bias is important.

A Behavior-Analytic Conceptualization of Cognitive Bias

As stated earlier, our main purpose in this paper is to offer a behavior-analytic account of cognitive bias, especially as it occurs in clinical contexts. Distilling the literature already presented, cognitive bias can be defined as the selective attention, recall, or interpretation of environmental and private events. It is generally studied in relation to emotional states, like depression or anxiety, and is proposed to explain those states or result from them. We take the position here that although cognitive bias is characteristic of certain emotional states or clinical disorders and may influence other behavior, it neither causes nor is caused by it. Rather, a thoroughgoing account must specify the antecedent events that produce emotional states that also evoke certain overt and covert behavioral repertoires, including those verbal repertoires commonly referred to as cognition. Thus, cognitive bias and associated emotional states result from certain environmental events and relevant behavioral processes. Particularly relevant in our view are motivating operations (Michael, 1982, 1993) and verbal processes (e.g., Hayes et al., 2001; Sidman, 1994; Sidman et al., 1986; Skinner, 1957).

Motivating Operations

As described by Michael (1982, 1993, 2000), motivating operations affect all three components of relevant contingencies of reinforcement and punishment. Accordingly, they differentially potentiate relevant consequences and increase the probability of behaviors that in the past have been effective in obtaining potenti-

ated reinforcers or escaping or avoiding potentiated punishers. Over the years, a number of different terms have been used to identify variables that serve these functions (e.g., *setting factors*, Kantor, 1959; *setting events*, Bijou & Baer, 1961; *potentiating variables*, Goldiamond, 1983; and *establishing operations*, Michael, 1982, 1993, 2000; for a review, see Leigland, 1984). *Motivating operations* now seems to be the most commonly used term (Friman & Hawkins, 2006; Laraway, Snyckerski, Michael, & Poling, 2003) and will be used here.

Food deprivation is an example of a motivating operation. For food-deprived organisms, food is potentiated as a reinforcer, food-seeking behavior increases in probability, and stimuli that have been discriminative for food reinforcement differentially gain control and salience. Food deprivation also abolishes or depotentiates non-food-related contingencies in that non-food-related consequences become relatively less reinforcing, behavior associated with these consequences decreases in relative frequency, and relevant discriminative stimuli become relatively less controlling and salient. In our view, the effects of motivating operations on stimulus control are most relevant to the current discussion of cognitive bias.

The effects of motivating operations on stimulus control. A less technical and more conventional way of saying that motivating operations differentially affect the stimulus control exerted by relevant discriminative stimuli is to say that we selectively attend to stimuli that are relevant to specific motivating operations. When we are food deprived, for example, we selectively attend to food-related stimuli, and this includes food-related stimuli that are not present in the immediate environment. For example, we may begin to recall (remember) the locations of places where food can be or has been obtained,

and we might even interpret ambiguous stimuli as being food related. This phenomenon has been called *motivated perception*, and was illustrated by Skinner's description of his use of the device he called the verbal summator (Rutherford, 2003; Skinner, 1936, 1953). Recall that the verbal summator was a device that generated a short series of repeating meaningless sounds that individuals were asked to listen to and interpret. Individuals frequently reported hearing words or phrases relevant to their current emotional or motivational states. Skinner suggested that the device could be used to assess individuals' "complexes," and there were attempts to formalize the use of the verbal summator as a projective technique (see Rutherford).

Although motivating operations are said to enhance the control exerted by relevant discriminative stimuli, the effects of motivating operations extend to stimuli whose control has been acquired by means other than differential reinforcement. Stimuli whose control is acquired through physical or semantic generalization, instruction, abstraction (Catania, 2007a, 2007b), equivalence, or other derived stimulus relations would be similarly affected. For example, through stimulus generalization, a thirsty child may respond appropriately to a novel cup that is physically similar to a cup from which he or she previously drank. The child may also reach for a water bottle after being instructed that they can be used for drinking, or may, in the right context, ask for a "taza" after learning that it is the Spanish equivalent of the English word "cup." These examples illustrate the crucial point that motivating operations affect controlling stimuli regardless of the process by which they acquired stimulus control over relevant operants.

With respect to cognitive bias, especially in clinical contexts, we can see that real-world events that

produce anxiety and depression (e.g., trauma, punishment, loss of reinforcement, criticism, etc.; Dougher & Hackbert, 1994) as well as laboratory-based mood-induction procedures can function as motivating operations. More specifically, these events elicit emotional reactions, but they also differentially potentiate relevant contingencies of reinforcement, thereby enhancing the stimulus control and salience of relevant discriminative stimuli.

Implicit in the concept of enhanced stimulus control is a differential increase in the probability of the operants they occasion *and* a differential decrease in the probability of operants occasioned by other, depotentiated stimuli. In a sense, then, motivating operations restrict both environments and repertoires. That is, there is an increase in the probability of all behavior relevant to the contingencies potentiated by a particular motivating operation, including private respondents and operants, and a decrease in the probability of operants relevant to most other contingencies. As an example, consider an individual who has recently experienced the unwanted break-up of a relationship. The loss of reinforcement certainly elicits strong emotional responses, but it also serves to enhance the stimulus control exerted by the range of stimuli associated with that failed relationship, increases the probability of relationship-related repertoires, and differentially potentiates the reinforcing value of repairing the relationship and getting back together. For example, the individual may differentially attend to the perfume of his or her loved one on a stranger, mistakenly see the loved one in places they used to frequent, have recurrent thoughts of good times, and obsessively replay events that led to the break-up.

The extent to which contingencies are affected varies as a function of individual learning history. Thus, an idiographic functional analysis is

necessary to determine what contingencies are differentially potentiated (Kanter, Busch, Weeks, & Landes, 2008). For example, after a break-up, some individuals may prioritize replacing the lost intimacy and may avoid work and other activities that were once reinforcing. For others, the prospect of becoming involved in another potentially punishing intimate relationship can become highly aversive, while other activities (e.g., work, substance use, sleep, eating) may become highly potentiated. Likewise, for some individuals, stimuli associated with the terminated relationship may elicit strong emotional reactions and selective memories and may evoke behavior that is intended to either mend the terminated relationship or find a replacement. For others, these stimuli may evoke behaviors intended to avoid reminders of the terminated relationship and opportunities to begin new ones. In addition, these stimuli may evoke verbal repertoires that include self-recrimination, blaming, and rumination in an attempt to understand or analyze the reasons for the break-up and to generate new rules that are intended to govern future relationships.

To summarize, when we experience the aversive effects of a failure or loss, we may come under the differential control of many stimuli that are affectively or semantically related to that event. This includes private stimuli, such as the verbal behavior or stimuli involved in trying to make sense of the loss and avoiding future failures. In a failure or loss situation, a range of contingencies is affected such that previously reinforcing consequences become associated with aversive stimulation, and are therefore more likely to be avoided. This creates a situation in which a limited range of stimuli acquires increasing control over behavior, resulting in a narrowed or restricted behavioral repertoire. Interestingly, this restricted range of potentiated contingencies

is characteristic of many clinical problems, especially anxiety and depression (Hayes et al., 2001; Wilson & Murrell, 2004), and is also a defining characteristic of cognitive bias (i.e., stimulus selectivity, inflexible cognitive patterns, and a limited range of emotional states).

Appeal to external motivating events may explain momentary instances of cognitive bias or differential stimulus control, but in individuals with clinical disorders, cognitive bias is often more pervasive and long lasting. The world is perceived, recalled, and interpreted in ways that can serve to self-perpetuate cognitive bias, the restricted repertoires and associated affect that characterize clinical disorders. Individuals with clinical disorders tend to generate biased rules or narratives about the world and themselves, and those rules are continuously validated via biased or potentiated perceptions, recollections, and interpretations. Because generating coherent narratives about environmental events and their relation to behavior may be reinforcing, individuals may be motivated to actively search for or selectively attend to events and apparent relations that are consistent with those narratives or explanations (Hayes et al., 2001; Pyszczynski & Greenberg, 1987; Rothbaum, Weisz, & Snyder, 1982; Swann, 1983, 1987). In that way cognitive bias can be self-perpetuating, but that self-perpetuating process seems to be dependent on the verbal behavior that is characteristic of these disorders. We turn now to a more detailed consideration of the role of verbal processes in cognitive bias.

The Role of Verbal Processes

Hayes et al. (2001) and Hayes, Strosahl, and Wilson (1999) have argued that once humans acquire language, verbal processes become dominant and pervasive and greatly influence the way in which we per-

ceive and respond to internal and external stimuli. Whether this statement is true awaits further empirical evidence, but it seems clear that, at least for language-able humans, many clinically important behaviors (as well as those relevant to cognitive bias) are accompanied by a stream of verbal behavior (naming, categorizing, comparing, interpreting, evaluating, etc.) that can and often does mediate the functions of those events (Hayes, Gifford, & Hayes, 1998; Ju & Hayes, 2008; Michael, 1982; Skinner, 1957). Although we take the position here that verbal behavior has important functional-altering effects and that a full account of complex verbal behavior must include an account of these effects, we fully acknowledge that mediating verbal behavior is itself ultimately the result of reinforcement contingencies (e.g., Hayes et al., 2001; Schlinger & Blakely, 1987).

Self-talk. Perhaps the most relevant verbal behavior for a conceptual analysis of cognitive bias is when the speaker and the listener are the same individual; this has been commonly referred to as *self-talk*. Self-statements can function similarly to external motivating operations and may be thought of as verbal motivating events. The inner dialogue evoked by a particular environmental event is a function of an individual's history, but the function-altering effects can be significant. Returning to the example of an individual going through the unwanted termination of a valued relationship, the ensuing self-talk may be characterized by self-blame, criticism, and attempts to create a coherent explanation. This self-talk itself may function as a verbal motivating operation not only in its ability to elicit more depressed affect but also in terms of its effects on relevant reinforcement contingencies and restricted stimulus control. Mistakes and transgressions made in the relationship and previous relationship failures are easily recalled, as

are other instances of failure in other domains (e.g., as a parent, employee, or friend). In an effort to make sense of the failed relationship, the individual may generate an explanation that selectively incorporates his or her perceived weaknesses and faults and arrives at a self-condemning conclusion.

The tendency to generate a coherent narrative or make sense of events in one's life has been observed by a number of researchers and given a variety of names, including forming a self-narrative (Gergen & Gergen, 1988; Pennebaker & Seagal, 1999), making or finding meaning (Janoff-Bulman & Frieze, 1983), posttraumatic growth (Calhoun & Tedeschi, 2000; Tedeschi & Calhoun, 2003), developing a sense of coherence (Antonovsky, 1979) story telling (Zettle, 2007), and making sense or reason giving (Hayes et al., 1999, 2001). This may be particularly so for events that elicit or evoke emotions (Schachter & Singer, 1962). Swann (1983, 1987) asserts that cognitive bias in depression may be due to the comfort that is found in a consistent self-narrative. Making sense has been proposed by Hayes et al. (2001) to reduce arousal associated with uncertainty. In fact, Hayes et al. (1999) assert that making sense can be reinforcing to such a degree that it becomes entirely pervasive and ineffective in solving psychological problems.

A preliminary laboratory study in an ongoing series of studies by Wray, Dougher, and Bullard (2008) explored whether making sense is reinforcing. The study compared participants' preference for a solvable computer task with response-contingent feedback to a formally similar but unsolvable task, on which equal or greater amounts of positive feedback were presented independent of the participant's performance. The majority of participants preferred the solvable task when equal amounts of positive feedback were presented, and

half of the participants preferred the solvable task even when greater amounts of positive feedback were provided for the unsolvable task.

A common form of self-talk that maintains negative mood states and cognitive bias despite temporal distance from the initial motivating operation is rumination. *Rumination*, which is particularly common in depression, is frequently defined as intrusive and recurrent thought that is often self-focused on the symptoms, causes, and consequences of the negative affect (e.g., Martin & Tesser, 1996; Nolen-Hoeksema, 1991). Nolen-Hoeksema asserted that rumination may allow individuals to focus inwardly and evaluate their problems. From a behavior-analytic perspective, rumination is viewed as verbal behavior that serves a variety of functions such as reducing uncertainty and arousal associated with the uncertainty (Hayes et al., 2001), avoiding more distressing thoughts (Behar, Zullig, & Borkovec, 2005), or avoiding aversive emotions (Hayes et al., 2001; Kanter et al., 2008). Because private events, including self-statements, are often experienced as aversive, individuals may try to avoid them.

Although rumination may be an attempt to ultimately reduce aversive private events, it is often only temporarily effective and typically increases in frequency over time. In fact, Nolen-Hoeksema (1991) asserts that a ruminative response style may explain why some individuals become clinically depressed after an aversive event and others do not. Rumination is a behavior that produces verbal stimuli that function to evoke negative affective states and aversive private events (e.g., memories) that serve to exacerbate, rather than ameliorate, these events. Studies show that experimentally induced rumination increases depressed mood and overgeneralized negative memories (e.g., Park, Goodyer, & Teasdale, 2004). Reciprocally, mood may in-

crease the likelihood of certain types of self-talk such that the more depressed an individual is, the more negative self-statements he or she makes.

Stimulus equivalence and derived relational responding. Self-talk can serve a motivative function and thereby perpetuate cognitive bias, but the processes by which verbal stimuli acquire this or any function need to be explained. Once relational responding is established, verbal stimuli acquire functions through their participation in equivalence relations with other verbal and nonverbal events. In general, once equivalence relations are established among a set or class of topographically distinct stimuli, a function acquired by one member of the set will transfer to the others (e.g., Dougher, Augustson, Markham, Greenway, & Wulfert, 1994). In this way, verbal stimuli acquire many of the psychological effects of nonverbal stimuli. This is why, as Friman, Hayes, and Wilson (1998) describe, reporting a past painful event can be painful in itself.

Equivalence is only one kind of stimulus relation (see Hayes et al., 2001, for a detailed theory of stimulus relations and relational responding), and it has been demonstrated that stimulus functions can be transformed in line with a number of other relations such as opposition, difference, before-after, and less than/greater than (Dymond & Barnes, 1995, 1996; Green, Stromer, & MacKay, 1993; O'Hara & Barnes-Holmes, 2001; O'Hara, Roche, Barnes-Holmes, & Smeets, 2002; Roche & Barnes, 1996, 1997; Roche, Barnes-Holmes, Smeets, Barnes-Holmes, & McGeady, 2000; Steele & Hayes, 1991; Whelan & Barnes-Holmes, 2004; Whelan, Barnes-Holmes, & Dymond, 2006). For example, using college students as participants, Dougher, Hamilton, Fink, and Harrington (2007) first trained arbitrary relations among three equally sized visual stimuli, A,

B, and C, so that A was responded to as smaller than B, and B was responded to as smaller than C. Then participants were trained to press the space bar on a keyboard at a steady rate in the presence of the B stimulus. Once a steady rate of bar pressing was achieved, the A and C stimuli were presented alone without additional instructions. All of the participants pressed the bar at a slower rate to the A stimulus and at a faster rate to the C stimulus than to the B stimulus. After that, the B stimulus was paired with mild electric shock six times in a classical conditioning arrangement, with skin conductance responses serving as the dependent variable. When the A and C stimuli were then presented in extinction, most of the participants showed a smaller skin conductance response to the A stimulus and a larger response to the C stimulus than to the B stimulus. Interestingly, because of the original relational training, the C stimulus, which had no previous association with shock, elicited a larger fear response than the stimulus that had been directly paired with shock. These data suggest that relational training influences the way in which individuals respond to stimuli with which they may have had no direct experience, and that individuals may impose functional relations on novel events as a result of their learned or derived relations with familiar stimuli.

One relation often imposed on stimuli that is particularly relevant to cognitive bias is causality. Although causality has not been well investigated as a stimulus relation, it is clear that individuals readily impose and derive causal relations among events. For example, Peterson and Seligman (1984) asked participants to describe the two worst events they had experienced within the last year, and the only instructions provided were to keep the description within a specified word limit. Results indicated that participants spontaneously offered causal

explanations without any prompting to do so. However, the types of explanations tend to vary as a function of individual learning history and affective states. For example, when depressed individuals explain an aversive event, they assigned causality to self-deficiencies (e.g., "My partner left me because I am unlovable"). These maladaptive causal explanations have repeatedly been demonstrated to correlate with clinical problems (Barnett & Gotlib, 1988; Fresco et al., 2006; Gotlib et al., 1993; Morrison et al., 2006; Raps et al., 1982; Stiensmeier-Pelster, 1989).

Motivating Operations Affect Self-Relations

Relational frame theory asserts that relational responding is a functional operant that is abstracted and comes under contextual control (Hayes et al., 2001, p. 29). If so, then relating should be a function of all of the variables that affect operant responding. There is evidence to suggest that relational responding can be brought under both antecedent stimulus control (e.g., Dymond & Barnes, 1995; Green et al., 1993; Wulfert & Hayes, 1988) and consequential control (Whelan & Barnes-Holmes, 2004; Whelan et al., 2006; Wilson & Hayes, 1996), but particularly relevant to our discussion of cognitive bias is the effect motivating operations might have on relational responding.

A recent within-subject experiment by Freund (2007) offers preliminary evidence for the effects of a motivating operation on self-relational responding. Nondepressed college students (as measured by self-report on the Beck Depression Inventory-II) were exposed to several practice trials on a version of the Implicit Relational Assessment Procedure (IRAP; Barnes-Holmes et al., 2006) computer task. The procedure requires participants to push a key corresponding to true or false as quickly but accurately

as possible to a set of “true” (“love is good”) or “false” (“love is bad”) statements under two different instruction conditions. In one condition, participants were instructed to respond in a way that is consistent with what they believe, and in the other, to respond in a way that is inconsistent. Thus, in the consistent instruction condition, participants would respond “true” to “love is good” and “false” to “love is bad.” In the inconsistent condition, they would respond “false” to “love is good” and “true” to “love is bad.” In this study, practice trials involved responding “true” or “false” to self-statements such as “I am sitting,” “I am standing,” “I am a student,” and “I am a doctor.” The operating assumption of the procedure is that participants will respond faster under consistent instructions than under inconsistent instructions, and that the difference in reaction times reveals the participants’ implicit relations among the elements in the statements.

Once participants had achieved stability on the IRAP practice trials, they were given a set of self-reference trials that included statements like “I am happy,” “I am sad,” “I am accepted,” and “I am rejected” and were asked to select “true” or “false” under consistent and inconsistent instruction conditions. Overall, participants more quickly endorsed positive self-statements as true and negative statements as false in baseline (i.e., during neutral or positive mood). After negative mood-induction procedures that consisted of reading a story of personal failure in an academic setting while listening to a piece of sad music, participants reported their mood on a mood checklist and were then reexposed to the self-reference IRAP. Nine of 15 participants reported a shift in mood, and subsequently responded faster to negative self-statements and slower to positive self-statements than they did in baseline. Thus, for most partici-

pants, the mood-induction procedures altered their self-descriptions or the relation between themselves and the positive and negative descriptors. Based on these preliminary data, if mood-induction procedures can be considered motivating operations, then motivating operations can alter self-relations.

To summarize, the behavioral phenomena that fall under the general rubric of cognitive bias are ubiquitous and are not restricted to clinical populations. The events we attend to, remember, and interpret are controlled by potentiated consequences and contingencies of reinforcement. In the present paper, we see cognitive bias as the product of motivating operations and verbal processes, especially arbitrary relational responding and the resulting transformation of functions. However, cognitive bias is particularly conspicuous in clinical contexts and contributes to the development and maintenance of clinical disorders.

CLINICAL IMPLICATIONS

The present account of cognitive bias suggests some implications for treatment of mood disorders. For instance, individuals may need to contact alternative motivating operations that will potentiate non-depressive contingencies following a motivating operation that evokes depressive contingencies. Some literature in support of this idea indicates that negative mood motivates people to actively seek out motivating operations to reverse the mood state and its effect (Sakaki, 2006; Siemer, 2005). Seeking out mood-incongruent activities is sometimes referred to as *mood management*, and has been seen in people who are depressed as well as those who are temporarily induced into mood states (Bower & Forgas, 2000; Swinkels & Giuliano, 1995). People deliberately search for strategies to repair their mood, and some methods used to reduce or

reverse mood states are more effective than others. For example, people who experience negative mood may use drugs or alcohol to alleviate their distress. This tends to be effective in the short term for reducing negative emotions, but it is ineffective as a long-term strategy.

Clinically depressed individuals appear to use less effective strategies to repair their mood than nondepressed individuals do. These individuals often use coping strategies, like avoidance and rumination, that enhance and maintain the negative mood. For example, depressed and formerly depressed participants reported using less adaptive strategies, like thought suppression, in response to unpleasant thoughts compared to participants who were never depressed (Rude & McCarthy, 2003). Depressives also paid less attention to and had less clarity about their feelings, and reported a relative unwillingness to disclose their feelings compared to nondepressed individuals (Rude & McCarthy). It seems that these less effective strategies, which are often characterized by avoidance of aversive private events, are potentially self-perpetuating in that they decrease the probability of contacting currently depotentiated but potentially reinforcing contingencies. For this reason, interventions that are intended to establish or potentiate nondepressive contingencies should be a component of therapy.

The motivating operations that potentiate mood-shifting contingencies can come from external sources (e.g., an experimenter's request, an event, therapeutic intervention) or self-talk (e.g., self-statements via conditioning and transformation of function). Studies have shown that brief distraction improved a temporary sad mood, whereas self-focused rumination worsened participants' sad mood (Bower & Forgas, 2000; Siemer, 2005). Additionally, it appears that focusing attention away from self-related stimuli and toward other-

related stimuli during a dysphoric mood may improve mood (Hertel & El-Messidi, 2006). Comparable effects were demonstrated in a series of three mood-induction experiments by Van Dillen and Koole (2007). These authors reported that performing a math task during a negative mood reduced this mood. In other words, simply interacting with a nondepressive contingency while in negative mood can significantly alter the mood.

Based on this analysis, treatment interventions such as behavioral activation, exposure, self-monitoring, cognitive restructuring, mindfulness, and acceptance are likely to be effective in decreasing depression because they expose clients to motivating events that potentiate alternative behaviors, consequences, and salience of discriminative stimuli. Behavioral activation, exposure, and self-monitoring (Korotitsch & Gray, 1999) contribute to client contact with increased environmental events, and cognitive restructuring, mindfulness, and acceptance work to change cognitive behavior or its function (Allen, Chambers, & Knight, 2006; Hayes & Wilson, 2003; Teasdale, 1999; Teasdale et al., 2002). These methods increase contact with alternative motivating operations while expanding one's overt and private behavioral repertoires.

Thus, distraction may be useful if it serves to contact other mood-incongruent motivating events that allow individuals to continue the pursuit of goals and values. However, this account (and writings of others, e.g., Hayes et al., 1999, 2001) suggests that attempts to reduce unwanted private experiences, for the sole purpose of reducing aversive affective states, may be unsuccessful because of the function-altering effects of verbal stimuli. Findings on the paradoxical effects of thought suppression with negative thoughts (Wegner, Schneider, Carter, & White, 1987) further suggest that treatments that highlight

distraction and suppression as integral components may not be effective, and at worst, may be iatrogenic. As an individual attempts to suppress unwanted thoughts, the attempts will inevitably fail at times (Wegner, 1994). As this happens, if the individual is in a negative mood, the stimuli that are being used as distraction from the aversive thoughts and affective state may acquire similar aversive functions via relational responding.

Behavior-analytic therapies, such as acceptance and commitment therapy (ACT; Hayes et al., 1999) or behavior activation therapy (BAT; Martell, Addis, & Jacobson, 2001), that take a different approach to unwanted private experiences offer great promise in the treatment of disorders that are characterized by cognitive bias. For example, ACT therapists focus on altering clients' responses to their private events and verbal behavior in an attempt to facilitate defusion and acceptance, and BAT therapists focus on increasing engagement with reinforcing motivating operations and rely primarily on the secondary effects of increased reinforcement to alter clients' moods and cognition or self-directed verbal behavior. Likewise, incorporating a psychoeducational component into existing treatments about the effects of mood on cognition might be useful in facilitating acceptance, defusion, or mindfulness of unwanted private events. All of these strategies may serve to alter the aversive functions of the unwanted experiences via exposure rather than to exacerbate the avoidance repertoires that maintain the clinical problem. Regardless of whether and how behavioral accounts of clinically relevant phenomena are integrated into specific therapies, it is important that these phenomena be understood.

Our conceptual analysis is based on established behavioral principles, but it is ultimately an interpretation. Although there is direct empirical

evidence to support some of our interpretations, a good deal more research is necessary to fill in the empirical gaps. One major difficulty in conducting research of this type with normal adults is the fact that they come to the laboratory with complex histories and well-developed verbal repertoires. That is, the repertoires of interest are already developed, and it is, therefore, difficult to gain experimental control over the range of relevant variables. Still, behavior-analytic studies of complex human behavior can be informative despite the lack of precise experimental control, and these basic findings are critical to move clinical behavior analysis forward.

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